beamline.

The optical configuration chosen tends to lead to operation at a single wavelength. However a system has been developed where two monochromator crystals optimized for 2 different wavelengths are mounted in the vessel in a double-decker arrangement. This allows the wavelength to be changed simply by translating between the two monochromators. The two wavelengths of operation for Station 14.1 are 1.2Å and 1.5Å. Table 1 gives an impression of the relative flux expected on Station 14.1 compared to the existing fibre diffraction station, Station 7.2.

| Station | Relative Intensity |
|---|---|
| 7.2/9.5 | 1 |
| 9.6 | 10 |
| 14.1 | 10-20 |
| 14.2 | 20-40 |
| BM14 (ESRF) | 20 |

**Table 1:** The Relative Intensity of Beamline 14 Stations

It is planned that initially the existing fibre diffraction equipment from Station 7.2 will be transferred to Station 14.1. The rotation camera on Station 14.1 was designed and manufactured at the EMBL in Hamburg, an earlier model is currently in use on Station 7.2. Initial commissioning of the station will be done using a MAR 30cm image plate detector. Ultimately an ADSC Quantum 4 CCD detector will be mounted on the station. This is a 180mm x 180mm 2 x 2 array of CCDs with a full-frame slow readout time of 9s. This drops to 3s if the fast readout option is used.

Plans are underway to develop a new fibre camera specifically for Station 14.1. Currently users' opinions are being sought on various design features such as sample alignment, helium beam path both before and after the sample, and the ability to move the sample in different planes. An outline design of the camera will be available by the end of March. This will then be refined before being manufactured to be available at the end of July. Anyone wishing to provide input into the design of the camera should get in touch with Rob Kehoe at Daresbury Laboratory (tel. 01925 603626, email r.c.kehoe@dl.ac.uk). Relevant web pages can be found via the Protein Crystallography web pages at http://www.dl.ac.uk/SRS/PX/index.html. The new Station Manager for Station 14.1 is Mike MacDonald (tel. 01925 603627, email m.a.macdonald@dl.ac.uk ). The Station Deputy is Rob Kehoe (tel. 01925 603626, email r.c.kehoe@dl.ac.uk).

## POLO Detector: 5 CCD SAXS/WAXS Area Detector for Synchrotron Radiation

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A novel area detector for SAXS/WAXS has been developed for use with synchrotron radiation. The detector is in fact two separate entities: one CCD for SAXS and 4 CCDs for WAXS. The detector has been designed to allow the simultaneous collection of time–resolved small and wide-angle scattering. The detector is based around 5 EEV 05-30 CCDs with resolution of 175μm each. The WAXS CCDs are angled at 22.5% to the X-ray beam, in a 2x2 mosaic with a hole at the centre of the array to allow the small angle signal to be transmitted to the SAXS detector at the rear of the instrument, see Figure 1. This arrangement allows the WAXS detectors to completely cover an angular range of 5° to 45° with a resolution of 0.05°. Using the diagonals of the mosaic, data up to angles 61° can be collected. Both WAXS and SAXS detectors are simultaneously collected at 30MB/s data rate, allowing time resolution down to approx 6 frames per second.

Each pixel value is digitised using low and high gain. The high gain channel has an adjustable offset allowing improved signal to noise characteristics for the selected range. This is particularly useful for

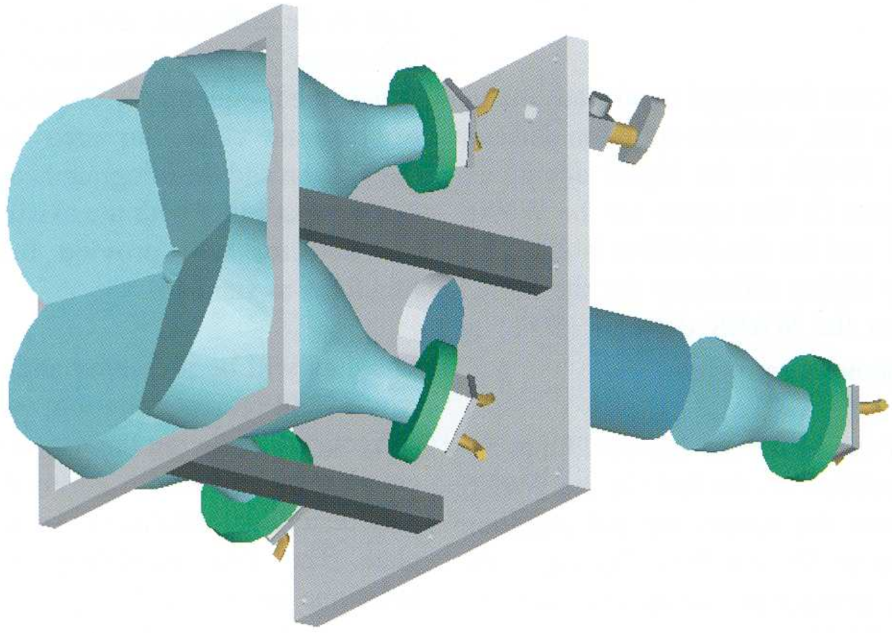

**Figure 1:** Schematic showing layout of the CCD tapers for WAXS and SAXS.

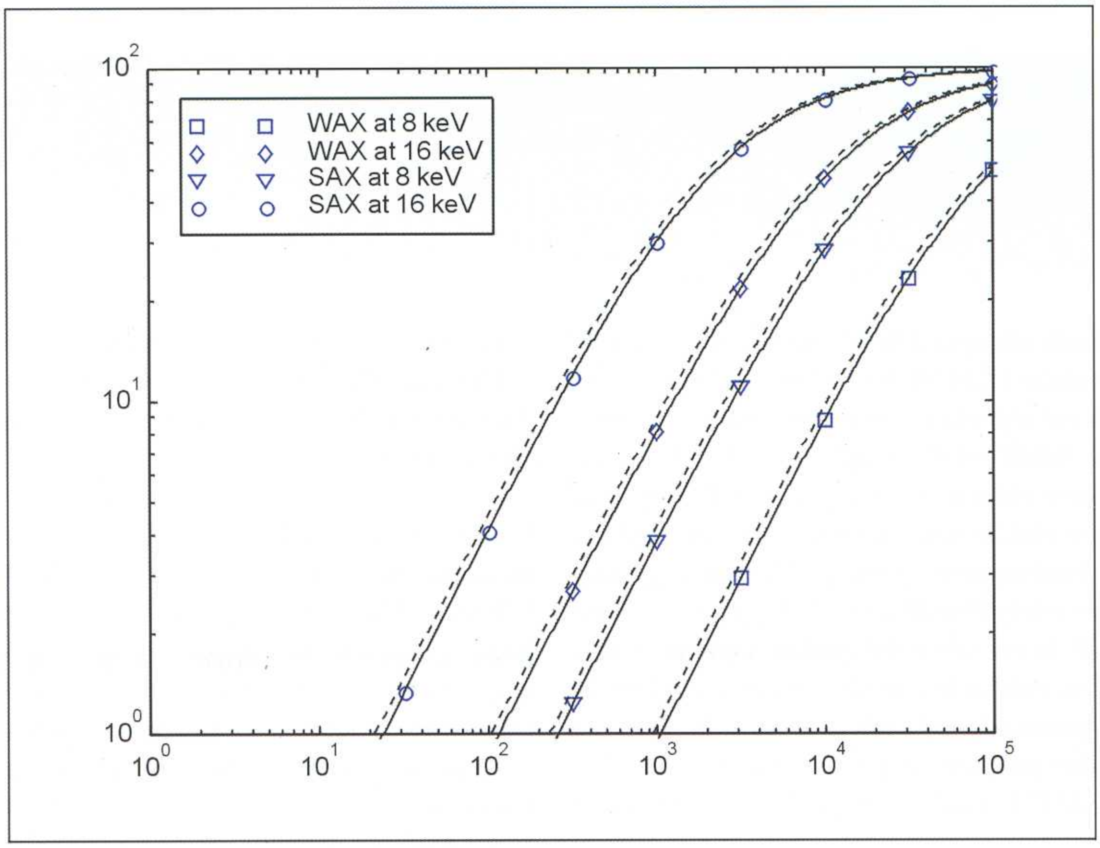


**Figure 2:** Detector Quantum Efficiency (DQE) as a function of intensity and photon energy.

discerning weak peaks in a high background as the high gain can be offset to the required background level.

The instrument has been developed to take advantage of station 16.1 at the SRS, with the optimum detector quantum efficiency (DQE) in the higher energy 16 keV range (see Figure 2). The tapers for the WAXS detectors are 3.88:1 and for the SAXS it is 2:1. This results in a slightly higher efficiency for the SAXS detector (90%) than the WAXS detector (80%) at 16keV and $2 \times 10^4$ photons per pixel.

The SAXS detector can be moved from 0.27m to 3m from the sample position. As the hole in the WAXS mosaic is offset from the centre, the full quadrant from the beam stop to 45° can be collected at the 0.27m position. A transparent beam stop will be mounted before the SAXS detector for the collection of normalisation data. The detector is designed to fit seamlessly into the existing Daresbury instrumentation. This will allow the SAXS detector to be replaced by the RAPID SAXS detector, if required.

In normal operation, data will be written to a 20Gb RAID ultra wide SCSI array allowing 2000 frames of data to be collected, before downloading the NCD file server. At slow frame rates, the full image of the data can be sequentially displayed on the console. At high frame rates, an area can be selected for integration and the integrated count can be displayed. For compatibility with the existing Daresbury set-up, the detector will provide the cycle and group functions as standard.

The data will be presented and saved with dark and white-field corrections but without geometrical corrections, allowing the user to select the preferred geometrical corrections during data reduction. These may be a transformation to reciprocal space or a flat plate. The data correlating each pixel to angular position, to allow these transformations to be performed, will be stored separately from the data set as is currently the case on existing equipment.

This detector is scheduled for delivery for January 2000 and should be available as a scheduled instrument shortly afterwards.

## CCP13 Software Development

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*There has been an upgrade of the existing CCP13 program, corfunc (T.M.W. Nye 1994), which can be used to perform correlation function analysis of one-dimensional small-angle scattering (SAXS) data. corfunc is now driven by a Java-based graphical user interface (GUI) and incorporates more robust non-linear least-squares fitting. The GUI greatly enhances the user-friendliness of the program and also allows it to be run with greater efficiency and flexibility. New interactive graphics allow corfunc to be run independently of other programs such as XOTOKO. The program is provided to run on NT / Windows, LINUX and various UNIX operating systems.*

### 1 Introduction

SAXS data can be subjected to correlation function analysis in order to derive structural parameters corresponding to the sample [1-2]. The correlation function is simply the Fourier Transform of the SAXS curve as shown in Figure 1.1. It is related to the electron density distribution within the sample as shown in Figure 1.2.

Figure 1.3 shows the structural parameters that can be obtained by interpretation of the 1-D correlation function. This interpretation assumes that the sample has an ideal lamellar morphology, *i.e.* it assumes that the sample consists of an ensemble of isotropically distributed stacks of alternating crystalline and amorphous lamellae. The stacks are assumed to be of dimensions that are large enough not to affect the small angle scattering.

### 2 The *corfunc* GUI

The Java-based GUI that drives the *corfunc* program (see Figure 2.1) can be run on any Java 1.2 platform or above (see http://www.javasoft.com). SAXS data